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ABSTRACT

Two studies examined how the factors of content-relevant knowledge and text organization influence students' abilities to study and to remember text information. The first experiment examined the effect of prior content knowledge on students' ability to identify important information in the text. Forty 7th- and forty 11th-grade students, experts and novices in baseball, read two texts, one on baseball and one on a less familiar topic. They then selected those segments of each text that they wished to have available to them as they tried to recall the entire texts. Experts in baseball selected the more important segments from the baseball texts, and they recalled more of the baseball texts than did the nonexperts. In the second experiment, the effect of prior knowledge on students' recall within and outside their domain of expertise and the effects of different text organizations (topic sentence placement and availability) within topic domains were examined. Subjects were 96 students from grades 5, 8, 11, and college. Results showed that students recalled more important information than unimportant, and more information within their domain of expertise than without. Neither topic sentence placement nor topic sentence availability influenced students' recall. The results of these experiments suggest that students who have prior content knowledge about a topic study more strategically and recall more from texts on that topic than students who lack such content knowledge. (Author/HTH)

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The Interaction of Knowledge and Text Structure on the ability to Identify Main Ideas in Texts

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Abstract

The present experiments examined how the factors of content-relevant knowledge and text organization influence students' abilities to study and to remember text information. the first study examined the effect of prior content knowledge on students' ability to identify important information in text. Experts and novices in baseball read two texts, one on baseball and one on a less familiar topic (e.g., Desert life). They then selected those segments of each text that they wished to have available to them as they recalled the texts. Experts in baseball selected the more important segments from the baseball texts and they recalled more of the baseball texts than non-experts. In the second study, the effect of prior knowledge on students' recall within and outside their domain of expertise and the effects of different text organizations (topic sentence placement and availability) within topic domains was examined. Students recalled more important information than unimportant information, and more information within their domain of expertise. Neither topic sentence placement nor topic sentence availability influenced students' recall. The results of these

experiments suggest that students who have prior content knowledge about a topic study more strategically and recall more from texts on that topic than students who lack such content knowledge. the implications for the development of improved instructional material and teaching techniques were discussed.

The ability to comprehend written material is an essential academic skill. Students are routinely asked to read to supplement information presented in class. Moreover, the teaching of reading skills makes up a large segment of the elementary school curriculum. The present experiments examine how two factors, content-relevant knowledge and text organization, influence children's abilities to study and to remember text material. Such research may encourage the development of better instructional materials and teaching techniques.

As children get older and more experienced they are better able to identify the important information in texts, to select that information for study, and to adjust their selection of study material after experience recalling the text (Brown, Smiley & Lawton, 1978; Danner 1976). As a result, older children recall more of the text content. Two possible explanations for this developmental increase in the ability to study and to recall text material are 1) that older children tend to know more about most text topics and that this content-relevant knowledge facilitates the discrimination of important and trivial text information and the subsequent recall of the content and/or 2) that older children know more about how texts are organized

(e.g., that important points are frequently expressed in initial sentences) and that this knowledge of text structure facilitates the identification and recall of text content. In the first study we examine how prior knowledge of a text topic influences the ability to study and recall an expository passage. In the second study we examine how prior knowledge of a text topic interacts with text structure to influence memory for text material.

Study 1

One usually effective study strategy is to focus on important information while only cursorily examining trivial material. Not only are important points more likely to be covered on exams but they also provide a framework for understanding and recalling supporting details. Before one can focus on critical points, however, one must be able to distinguish important from unimportant material. Thus, the ability to discriminate central ideas from details is an essential skill that underlies efficient study.

Students' ability to identify main ideas in prose is influenced by several factors including the length of the text, its complexity, and the method used to assess their skill. Although second grade children can describe the main point of a short, simple story (Danner, 1976), differentiation of fine gradations of

importance within longer, more complex texts is not reliably demonstrated until the eleventh and twelfth grades (Brown & Smiley, 1977). Similarly, when the task is changed and students are asked to select a segment of text to use as a retrieval cue, second graders do not reliably select important ideas whereas sixth and seventh graders do (Brown, Smiley, & Lawton, 1978; Danner, 1976).

The ability to identify main points in prose passages is probably also influenced by how familiar the student is with the material contained therein. Presumably, students who have no prior knowledge about a text topic would have more difficulty locating major ideas than would students who had considerable expertise in the area. The texts used in previous research might be termed moderately familiar. That is, they covered topics for which students probably had some, but not extensive, prior knowledge. The present study is designed to assess whether students' ability to identify main points is indeed enhanced when they read texts that cover highly familar material. Therefore, students who were experts in an area (baseball), read two texts, one on baseball and one on a less familiar topic (e.g. Desert life). They then selected those segments of each text that they wished to have available to them as they recalled the texts.

Method

Subjects

Forty seventh and 40 eleventh graders participated in the experiment. Twenty children in each age group were experts in the field of baseball and 20 were non-experts. Although approximately equal numbers of males and females participated, more males fell into the expert category and more females fell into the non-expert category. This sex difference was probably due to the nature of the topic of expertise (baseball).

Materials

A 20-item multiple choice test about baseball was constructed. Subjects who scored very high on this test were designated as experts and subjects scoring very low on this test were designated as non-experts. The mean score on the baseball test was 17.68, SD = 1.35, for the experts and 7.54, SD = 2.06, for the non-experts.

Four 32-sentence texts were written, two on baseball (Playing Second Base and Playing Third Base) and two on unrelated topics (The Desert and Noise). All of the texts were between 501 and 531 words in length, and were written at a fifth grade reading level (5.33, 5.58, 5.28, and 5.80, respectively). Retrieval cue cards were constructed by typing each text onto 3 X 5 cards. Each card had one

sentence from one text typed on it.

Procedure

Students participated in three sessions. In the first session subjects were given the 20-item multiple choice test on baseball. Those subjects scoring at or above 16 were designated as "experts", and those scoring at or below 10 were designated as non-experts. Subjects scoring in the middle range did not participate in the remainder of the study.

Procedurally, the next two sessions were identical except for the text assigned each student. Students were given one of 2 texts: half received one of the baseball texts and half received one of the unrelated texts. Students read through their assigned texts, and then were given the retrieval cue cards. They were asked to select the eight cards (1/4 of the total cue cards available) that would be most helpful to have available to them as they recalled the text. After selecting the cue cards, subjects were asked to recall as much of the text as they could using the cues they had selected as memory aids. Assignment of texts was counterbalanced across the sessions. For example, half of the subjects who were given Desert in the second session, were given Third Base during the final session while the other half of the subjects who were given the Desert text were given Second Base during

the final session.

Results and Discussion

Cue card selection

The retrieval cues had been rated for their importance on a four-point scale by an independent group of college students. The most important cues were given a rating of four and the least important cues were given a rating of one. Thus the proportion of cues selected at each level of importance could be calculated. Those proportions, broken down by grade, knowledge level and text topic, are presented in Table 1. These proportions are not independent from one another and so cannot be subjected to a single analysis of variance. The primary hypotheses, however, concern how prior knowledge of a text topic influences students' ability to focus on very important content. Therefore, only the most important cues (those that received a rating of four) were analyzed in a 2(Grade--7th, 11th) X 2 (Knowledge level--expert, novice) X 2 (Text topic--baseball, unrelated) mixed analysis of variance. Grade and knowledge were between subject factors; text topic was the within subject factor. Significant main effects of Grade $F(1,38) = 5.48$, $p < .05$; Knowledge level, $F(1,38) = 4.46$, $p < .05$; and text type, $F(1,38) = 6.02$, $p < .05$ emerged. Eleventh graders selected a greater proportion of very important cues than did

seventh graders (mean proportion of level four cues selected = .45 and .38, respectively. Experts selected a greater proportion of very important cues than did non-experts (mean proportions = .45 and .39, respectively). A greater proportion of important cues was selected from the unrelated texts (.45) than from the Baseball texts (.38). Hypothetically, students who have little prior knowledge about baseball would have particular difficulty identifying the most important ideas contained in texts on that topic. In other words, an interaction between knowledge level and text topic might be found. Although the means presented in Table 1 indicate that novices did, indeed, select fewer of the most important cues from the baseball texts, the predicted interaction was not reliable.

Insert Table 1 about here

Recall

The proportion of text information recalled (excluding the retrieval cues) was analyzed in a 2(Grade--7th, 11th) X 2(Knowledge level--expert, novice) X 2(Text topic--baseball unrelated) mixed factor analyses of variance. The between subject factors were Grade and Knowledge level; Text topic was the within subject factor. Significant main effects of Knowledge

level, $F(1,38) = 7.13$, $p < .01$ and Text topic, $F(1,38) = 5.26$, $p < .05$ were obtained. Novices did not recall as much as did experts (mean proportions recalled = .063 and .093, respectively). Recall of the baseball texts was poorer than of the unrelated texts (mean proportion recalled = .066 and .091, respectively). The Grade by Knowledge level interaction was also reliable, $F(1,38) = 6.93$, $p < .01$. Overall seventh grade baseball experts recalled somewhat more than any other group (mean proportions recalled = .12, .06, .07 and .07 for seventh grade experts, seventh grade novices, eleventh grade experts and eleventh grade novices, respectively).

Considered jointly, the retrieval cue selection and recall data are somewhat contradictory and provide only limited support for the hypothesis of the study. On the one hand, recall was extremely poor. Of course, retrieval cues were not included when the proportion recalled was calculated. Thus, students were not given credit for one-quarter of the texts that they did, in fact, include in their recall protocols. Moreover, the texts were fairly lengthy and students could not be expected to remember all the information contained in them. Nevertheless, generalizations from such minimal recall probably should be avoided.

The retrieval cue selection data are somewhat

stronger than the recall data. Although the hoped for Knowledge level by Text topic interaction was not significant, students who did not have much prior knowledge about baseball did seem to have slightly more difficulty locating the most important ideas in the baseball texts. Importantly, the novices in this study were not completely ignorant about baseball. In fact, some may have had as much general knowledge about baseball as they did about the unrelated text topics. Viewed from this perspective, novices' difficulties with the baseball texts becomes more striking.

Study II

The results from the first study indicated that students' ability to study and to recall prose passages is indeed influenced by how knowledgeable they are about the topic of the text. This second study extends those results in two ways: 1) by examining in greater detail students' recall of text both within and outside their domain of expertise and 2) by determining whether the organization of a text affects experts and novices differently.

The organization of a text has been shown to affect comprehension. A well-structured text takes less time to read (Kieras, 1978), is better remembered (Bower, 1976; Mandler & Johnson, 1977; Day, Stein, Trabasso & Shirey, Note 1), and is easier to summarize (Kieras,

1978; Kintsch & Greene, 1978) than a poorly organized one. These facts have led researchers to hypothesize that texts have certain "ideal" forms which readers expect to encounter. The readers' expectations guide the selective encoding of text information (comprehension), its retrieval from memory, and summarization processes (Rumelhart, 1975; Kintsch & vanDijk, 1978). Therefore, a good deal of effort has recently been devoted to identifying ideal text structures. Although most of this research has been carried out with simple stories (Mandler & Johnson, 1977; Stein & Glenn, 1977), some attention has been given to expository texts (Myer, 1975) and to descriptive paragraphs (Kieras, 1978; Mosenthal, 1979).

In research with expository texts, two aspects of structure are commonly manipulated: 1) whether a topic sentence is explicitly stated (Brown & Day, 1983) and 2) where the topic sentence appears within the paragraph -- e.g., whether it is the first sentence or the last (Kieras, 1978). Both of these manipulations affect comprehension. Subjects are better able to understand passages in which the topic sentence is explicitly stated as the first sentence of the paragraph (Kieras, 1978). Comprehension declines when the topic sentence is either omitted (Brown & Day, 1983) or is placed in the final position in the paragraph (Kieras, 1978).

Thus, it has been argued that the ideal form for simple expository paragraphs is a topic sentence first, followed by sentences which independently support it (Kieras, 1978).

Although these data seem quite clear, there are problems with accepting them at face value. One important problem is that professional writers seldom produce passages that match the ideal form (Braddock, 1974). The explicitness and location of topic sentences in professional prose vary considerably. Since readers do deal with professional writing, they probably learn how to cope with "non-ideal" texts--at least when the text topic interests them. In the present study we hypothesized that students' ability to understand a text would be jointly affected by its organization and by its content. Specifically, we expected that the placement and/or availability of a topic sentence might not influence comprehension when the text content was within a student's domain of expertise but that comprehension might be adversely affected when the text structure was "non-ideal" and the student had little prior knowledge about its content.

Method

Subjects

Ninety-six students, 24 at each of four grade levels, fifth-, eighth-, and eleventh-graders and

college students, participated in the experiment. All subjects were experts in baseball and novices in boxing.

Materials

To assess subjects' knowledge of baseball and of boxing two separate 20-item multiple choice tests were constructed: one on baseball and one on boxing. Subjects who scored high on the baseball test (16 or more correct out of 20) were designated as experts. Subjects who scored low on the boxing test (12 or less correct out of 20) were designated as novices.

Eight short expository paragraphs, four on baseball and four on boxing, were written. All of the paragraphs were written at the fifth grade level. The eight paragraphs were rewritten so that they would satisfy all of the experimental conditions. The experimental conditions were: topic sentence first and present; topic sentence first and absent; topic sentence last and present; and topic sentence last and absent. Because of the time constraints involved, as well as the possibility of fatigue, students received only four of the eight possible paragraphs, two paragraphs in each domain and two in the other domain while other subjects received the complement of the conditions in each domain. For example, if one student read two baseball texts, one with the topic sentence first but absent, and the other with the topic sentence last and present, then

she/he read two boxing texts one with the topic sentence first and present, and the other with the topic sentence last and absent. A second student would receive the opposite conditions in each domain. For the topic sentence absent conditions, a sentence was inserted into each paragraph so that the paragraphs could be kept at a constant length of eleven sentences across conditions.

Procedure

Each subject participated in two sessions. The first session was a brief fifteen minute period in which students took the multiple choice tests on baseball and boxing. Only those students who were experts in baseball and novices in boxing participated in the remainder of the experiment. The means on the baseball test for each group were 17.41, 18.00, 18.04, and 19.92 (respectively for fifth, eighth, eleventh, and college students). The means on the boxing test for each group were 5.36, 5.62, 7.37, and 9.67 (respectively, for fifth, eighth, eleventh, and college students). The next session lasted about forty minutes. During this session subjects were asked to read their four assigned paragraphs carefully because they were going to be asked questions about them when they were finished. When they were finished reading all the paragraphs, students completed a one-minute interpolated task (a word search puzzle) and then were asked to recall the four

paragraphs in the order that they had read them.

Scoring Procedure

To assess the quantity of recall, subjects' recalls were scored using the Turner and Greene (1977) method of propositional scoring developed from Kintsch's (1970, 1972, 1974) propositional theory of representation. All recalls were scored by one rater. A reliability check on the scoring procedure was done by having another rater score a random selection of 25 recalls. The interrater reliability was .93.

To examine the quality of the subjects' recalls, an independent group of college students rated the pausal units of the texts according to their level of importance to the overall meaning of the text (very important or unimportant). Subjects' recall protocols were scored according to these ratings. The proportion of propositions of each importance level recalled was calculated from each level available within each text.

Results

Quantity of Recall

Because subjects' received only four of the possible eight paragraph conditions, the unavailable scores were treated as missing data in the analyses. A 4(Grade) X 2(Domain) X 2(Placement) X 2(Availability) mixed measures analysis of variance was performed on the total number of propositions recalled by each subject on

each paragraph. The between factor was grade and the within factors were domain, placement, and availability. Significant main effects of Grade $F(3,262) = 165.62$, $p < 0.0001$ and Domain $F(1,262) = 140.37$, $p < 0.0001$ were obtained. Fifth graders recalled the fewest propositions, followed by eighth graders and finally, college students and eleventh graders (means = 7.91, 12.35, 17.69, 21.39, respectively). Post hoc comparisons using Duncan's Multiple Range Test showed significant differences between all means at the .05 level. Significantly more propositions were recalled in the baseball domain than in the boxing domain (means = 17.57 and 12.11 respectively). Thus, subjects were able to recall more of texts within in their domain of expertise. Interestingly, the Grade X Domain interaction did not emerge. Students at all grade levels recalled more information in their domain of expertise. Neither the main effects of Placement $F(1,262) = 0.00$, $p < 0.97$, nor Availability $F(1,262) = .84$, $p < .36$, were reliable. Paragraphs in which the topic sentence was placed first were not recalled better than paragraphs in which the topic sentence was last (mean = 14.85 and 14.83, respectively). Furthermore, paragraphs in which the topic sentence was present were not recalled better than paragraphs in which the topic sentence was absent (means

= 15.05 and 14.63, respectively).

To test the rival hypothesis that subjects recalled more in the baseball domain because the baseball paragraphs were easier than the boxing paragraphs a separate experiment was performed. Ten college students who were experts in both boxing and baseball were given a sample of the experimental paragraphs to read and recall. Subjects' expertise was assessed using the same test as employed in the primary study. The topic sentence was available in all of the paragraphs but the placement of the topic sentence varied from first to last. A 2(Domain) X 2(Placement) analysis of variance on the total number of propositions was performed. No main effect of Domain $F(1,19) = 1.24$, $p < .28$ emerged in this study. Subjects performed equally well in both text domains (means = 24.75 for boxing and 22.75 for baseball). As in the main study, the effect of topic sentence placement was not reliable, $F(1,19) = 2.78$, $p > .11$. Recall was unaffected by whether the topic sentence appeared as the first or as the last sentence in the paragraph (Means = 25.25 for topic sentence first and 22.25 for topic sentence last).

Quality of Recall

A 4(Grade) X 2(Domain) X 2(Placement) X 2(Availability) X 2 (Importance level) mixed measures analysis of variance (treating unavailable scores as

missing data) was performed on the proportion of each of the two levels of importance recalled. The between factor was grade and the within factors were domain, placement, availability and importance level. Significant main effects of Grade $F(3,625) = 88.08$, $p < .0001$, Domain $F(1,625) = 68.80$, $p < .0001$, and Importance level ($F(1,625) = 26.60$, $p < .0001$ emerged. As in the preceding analysis, younger subjects recalled less than older subjects (Means = .12, .18, .30, .25 for fifth-, eighth-, eleventh-, and college students, respectively). Duncan's post hoc comparisons revealed significant differences between all the grade level means at the .05 level. Thus, as subjects get older they recalled more information at both importance levels across both domains. Also, consistent with the quantitative data, subjects recalled a greater proportion of information within their domain of expertise than outside it (Means = .25 for Baseball and .18 for Boxing). Finally, subjects recalled more of the important units of the texts than of the unimportant units (means = .24 and .19, respectively).

General Discussion

The results of these studies indicate that students who have pre-existing knowledge about a text topic do indeed study more strategically and recall more of the text than do students who lack that knowledge.

Similarly, students who simply read a text recall more of its most important content if the topic is within rather than outside their realm of expertise. These beneficial effects of prior knowledge are obtained with junior-high through college-age students and are unaffected by deviations in text structure.

The enhancing effects of prior knowledge were revealed in comparisons of highly familiar and moderately familiar texts. None of the texts used in the present studies were completely novel to the students. Even the so-called "boxing novices" had some, albeit limited, understanding of that sport. We would predict that students would have extreme difficulty comprehending entirely novel content. Fortunately, students should rarely encounter texts for which they have absolutely no relevant background knowledge. Nevertheless, instructional implications are clear. Teachers can foreground students' preexisting knowledge or can provide relevant background <u>before</u> students are asked to read relatively unfamiliar material. Students can even be taught to mobilize prior knowledge for themselves, for example, by instructing them to always read text titles and to think about what they know about the topics before they continue on to peruse the texts. These instructional practices would not only improve students' study of and memory for particular text

information but would also provide them with a general learning strategy applicable across many academic tasks.

Merely activating or providing background knowledge will not solve students' every reading difficulty. Students need "tricks" for identifying main points in texts which contain novel material. An interesting extension of the present studies would be to use texts on highly familiar topics to teach students strategies for locating main ideas (e.g. attending to key words like "therefore" or "thus" that signal importance and/or detecting and utilizing redundancies as clues to importance). Since students can comprehend such texts easily, their cognitive energies could be applied toward practicing and refining the instructed strategies rather than toward figuring out what is written. Less familiar topics could be introduced after the students demonstrated some mastery over the instructed strategies. Because the initial learning situation would be relatively non-taxing, students would be more likely to acquire the strategies and to see their utility. Thus, students would be more likely to employ the strategies on other, less familiar, texts.

Finally, we would like to comment on the fact that neither topic sentence placement nor topic sentence availability influenced students' recall. Such a finding not only contradicts common-sense notions of

good writing style but some previously published data as well (e.g. Kieras, 1978). Nevertheless, we believe this finding is both reliable (e.g., Day, 1982) and important. We would argue that there is more than one way to write a readable paragraph and that students are more flexible text-processors than is usually acknowledged. Indeed, since most professional prose does not contain explicit topic sentences (Braddock, 1974); "ideal" text forms are rarely encountered. Therefore, instruction that misinforms students by leading them to expect topic sentences to appear as opening statements are misguided. Instead we should sensitize students to the many excellent ways of expressing ideas in writing.

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